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CONTROLLED FELLING OF LARGE TREES TO PREVENT BREAKAGE

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ABSTRACT

Occasionally large trees need to be felled in a manner which prevents breakage and subsequent disruption of components of the crown and stem. Controlled felling of large trees in high use areas also is frequently needed to prevent damage to neighboring trees. Procedures employing a system of letdown ropes, pulleys, and manpower are described to fulfill these needs. This system provides near maximum safety, entails a minimum cost, and can be used in a wide variety of forested environments.

Occasionally for experimental purposes, large trees need to be felled so that, when brought to the ground, their limbs, foliage, and stem remain intact. There are also many other situations for which a simple, controlled felling procedure could be advantageously employed to remove undesirable large trees; e.g., in residential or administrative areas, near utility lines, or in campgrounds and other recreational units, where heavy equipment cannot be operated and where damage to surrounding trees and property should be avoided.

When one of our studies was terminated in 1968 on the Priest River Experimental Forest, various components of crowns and stems of 27 trees of western white pine (*Pinus monticola* Dougl.) had to be measured and weighed (fig. 1). Ranges in characteristics of these trees were:

Total above-ground fresh weight: <550 to 4,630 pounds
Live crown length: 16 to 99 feet
Total height: 52 to 138 feet
Diameter at 1.6-foot stump: 4 to 20 inches

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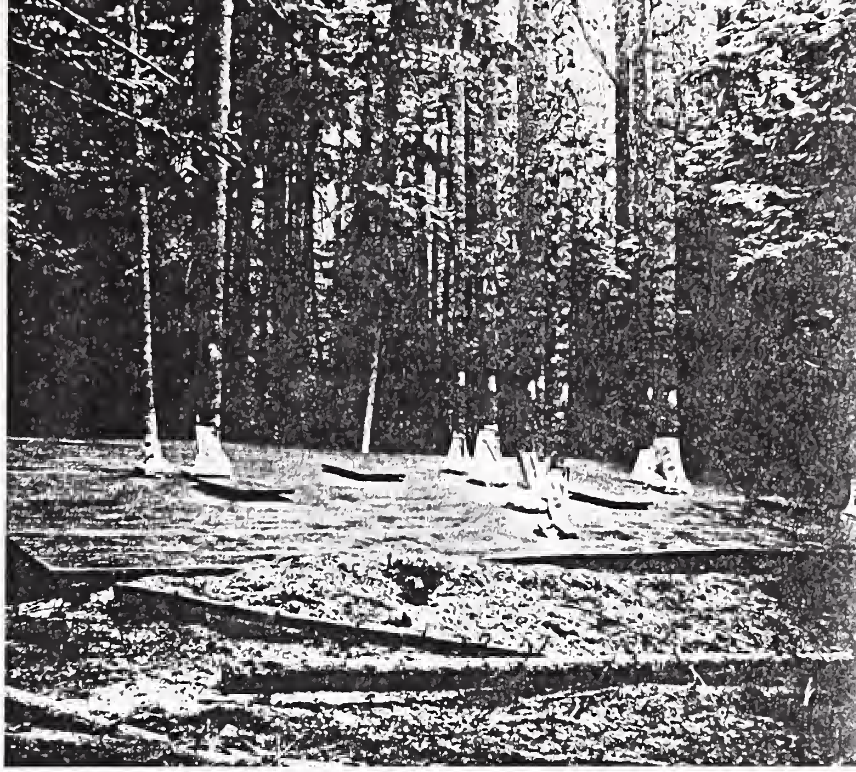

Figure 1.--Representative western white pine trees later felled by procedures described here. The numbered trees were felled in the direction toward the lower right corner of the shelter which was dismantled prior to felling. Diameters of trees here, at 1.6-foot stump, ranged from 5.5 (No. 1) to 18 inches (No. 8).

Our experience in piecing together the crowns of some of the taller trees after they had "free fallen" forced us to find a system of lowering the remaining trees to the ground to prevent considerable stem and branch breakage and crown disruption and to maintain accuracy of component sampling. That system is reported subsequently with the belief that it can be utilized in similar or other situations with appropriate modifications.

PROCEDURES

The steps that we found through trial and error to be most efficient and conducive to the safety of the operation are listed here in the recommended sequence.

1. The pathway along which the tree is to be laid down is cleared of debris, brush, trees, etc. This pathway can often be used for several sample trees when taken from small clusters.

2. The sample tree is climbed to the lower limit of the live crown. Dead limbs are removed flush with the bole during climbing. In order to prevent inadvertent loss of any live crown, we rarely went above its lower edge.

Material needed for step 3 may be carried with the climber or raised with a drop rope. For steps 3 through 6, refer to figure 2 as appropriate.

3. At the lower limit of the live crown, a 7/8- to 1-inch heavy link chain is double looped around the stem and fastened so that one loop drops below the other. A single block pulley, threaded with the let-down rope, is secured to the lower loop. A rope[2] is fastened just below the pulley attachment to provide equally trailing ends (two ropes of equal lengths would substitute adequately). The latter ropes serve as guides to keep the sample tree descending in the direction intended and are played out accordingly and in concert with the let-down rope.

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[2] All ropes were secured with bowline knots which were readily untied even after the loads exerted here.

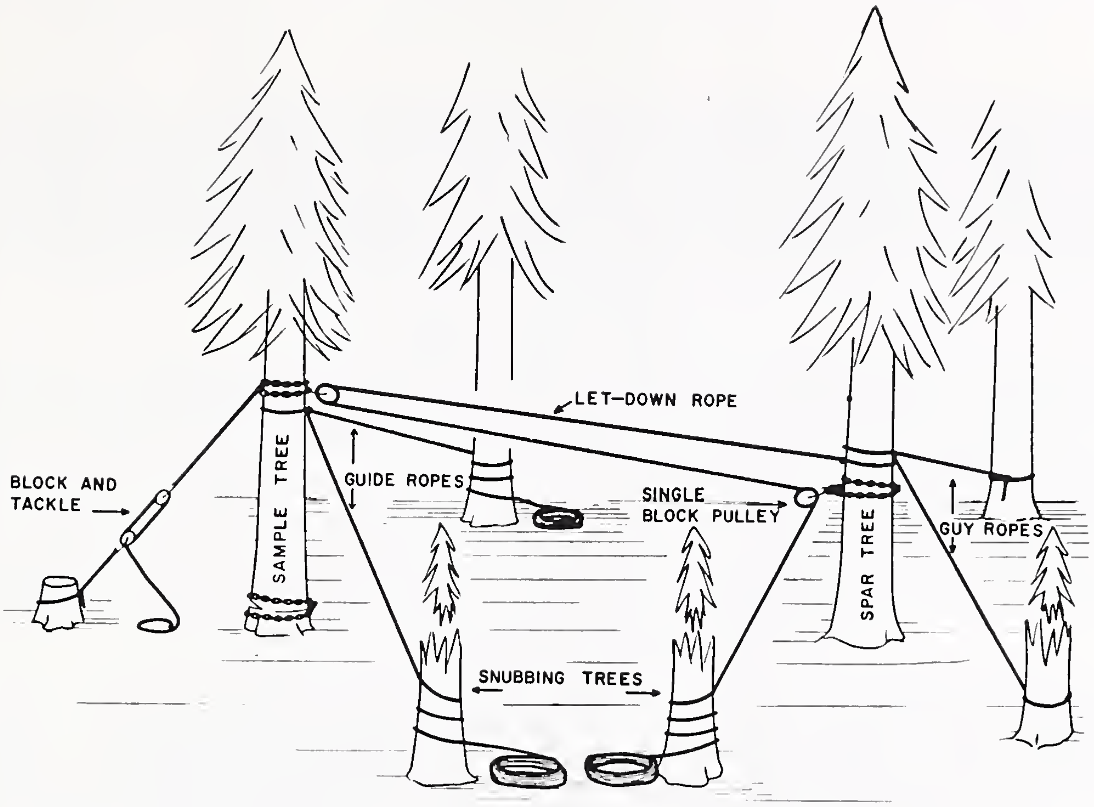

Figure 2.--Diagram of rigging for felling large sample trees.

4. A "spar" tree is selected behind and as near in line with the sample tree and its direction of descent as possible. One end of the let-down rope from the pulley on the sample tree is tied to the spar tree and the other end is run through a pulley, which is secured just below it and in the same manner as the one on the sample tree. The trailing end of this rope is then quadruple-looped around the base of a nearby large "snubbing" tree and coiled so that it can be played out without interference as the sample tree is lowered. Each trailing end of the guide ropes can at this point be likewise secured to sturdy snubbing trees located 45° to 90° from the let-down rope between the pulleys. Guy ropes are secured to the spar tree above the tied end of the let-down rope and to snubbing trees opposite the direction of intended fall.

5. A block-and-tackle or come-along is attached to the chain (preferably at step 3) holding the pulley on the sample tree and snubbed to a solid object toward the direction of tree fall. This arrangement will assure the tree starting in the direction intended and counteracts the weight and pull of the ropes and pulleys toward the opposite direction.

6. An undercut is made either as a downcut or an uppercut on the side of intended fall. We found the latter to be satisfactory, but the former may be safer; i.e., reduce stump jumping. The back cut is then made so that it comes within 2 to 2-1/2 inches of the undercut and approximately parallels it; a much wider uncut strip often results in a "barber chair" while a narrower strip is likely to break loose and, thus, eliminate the desired fulcrum effect. This 2-inch strip of uncut wood provides adequate stability as the tree is lowered and is usually of sufficient strength to prevent the tree from jumping off the stump. This latter possibility is insured against or at least controlled by a chain fastened around the stump and the tree butt after the back cut is made.

After this chain is fastened, the block-and-tackle is tightened until the tree leans sufficiently to descend alone. The tree may then be lowered under controlled release of the guide ropes by gradual release of the let-down rope. Some damage to snubbing trees, particularly by the let-down rope, may happen when its friction removes underlying bark. In no case did we expose living bark or cambium since we snubbed to thick-bark species, such as western larch (*Larix occidentalis* Nutt.), but thin-bark trees would be damaged.

SAFETY PRECAUTIONS

The above procedures can be used relatively safely provided certain precautions are taken. The ropes, chains, and pulleys must provide a safety load factor beyond their rated ones for the weights of trees lowered. While load ratings can easily be obtained for these materials, it is unfortunate that few data are available to obtain very accurate estimates of tree weights for all sizes and species of trees. Young and his coworkers have been most active in providing complete tree data (e.g., Young and Carpenter 1967; Young, Strand, and Altenberger 1964); but, from these data and others (Fahnestock 1960) that provide partial information, one should be able to reasonably estimate tree weights. A safety factor of at least one time greater than the estimated load should probably be used as a guide in procuring equipment.

The let-down rope should not be twisted between the sample and spar trees, and its trailing end and those of the guide ropes should be coiled so that they play out freely. The number of loops around snubbing trees, especially for the former rope, should be at least four in number to provide necessary friction for gradual playout. The number of loops required will vary with the size and bark characteristics (coefficient of friction) of the snubbing tree, the diameter of the rope, and the force required at the trailing end of the let-down rope. The first experience will guide subsequent felling operations.

The spar tree should be sound and at least as large as the sample tree. It should be securely anchored by guy ropes, as illustrated (fig. 2). When the spar tree pulley is located approximately 20 feet above ground as was our usual practice, the sample tree may free fall any time after its top is within about 20 feet of the ground, but little crown damage will occur. Our reason for placing this pulley so low was to avoid chances of spar tree breakage or tip over. Higher placement of the pulley would have provided better control over the final stages of let down but also would have increased costs of spar tree preparation including its anchoring. Worth mentioning in this respect is one incident where we used a slightly smaller spar than sample tree and anchored it with only one guy rope. When the sample tree was at about 45° in descent, the guy rope slipped up its snubbing tree. This caused the spar tree to lean. This lean along with the slightly upward force exerted toward the sample tree pulley caused the spar pulley, its holding chain, and the secured end of the let-down rope to slide up the spar tree when the bark failed and slipped on the woody cylinder at the points of attachment. (White pine, and other species, peel very readily in the spring, the time of our operation.) The result of these successive failures was a more rapid than desirable descent of the sample tree and breakage of the sound, though smaller, spar tree at about 35 feet above ground.

Each sample tree usually required a new spar tree in order to achieve reasonable alinement with the let-down area. We also advise the let-down crews (usually numbering about two men on each rope) to be clear of direct snapback of the ropes they are handling and to be shielded by trees from all of these ropes as well as from the pulleys and the spar tree. As indicated above, alertness to all phases of the operation by all crews is a prerequisite since all systems are "go" once the sample tree is in descent.

CONCLUSIONS

Obviously, more elaborate systems of tree let-down have been used (Young, Gammon, and Hoar 1963; Young and Chase 1965), but we found the above procedures easy to employ, cheap, manageable, and safe as long as the above precautions were adhered to. All equipment described here can be moved rather easily over any terrain to any forested sample point. Small trees, weighing perhaps less than 750 pounds, could literally be hand lowered with let-down ropes. The time involved to rig and fell even the largest trees rarely exceeded one hour, but these trees required a total of six to eight men during the actual let-down to man the ropes and to direct operations. However, it took more than 10 man-days to piece together a large, free-fallen tree, and uncertainty still prevailed over exact relocation as well as completeness of the sample components, such as foliage.

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